Sorensen

L SERIES
LABORATORY DC POWER SUPPLY

Instruction Manual

LS Models:

LS 18-5
LS 30-3

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Document No. M360378-01 Rev. A

September 23, 1996

SORENSEN, DIVISION OF ELGAR
LIMITED WARRANTY

All L Series power supplies are guaranteed for one (1) year from the date of delivery against defects in material and workmanship. This does not apply to products damaged through accident, abuse, misuse, or unauthorized repair. Sorensen shall not be liable for any special or consequential damage of any nature.

Sorensen will repair or replace the non-conforming product or issue credit, at its option, provided that Sorensen's inspection establishes the existence of a defect. Packing, freight, insurance, and other charge incurred in returning the defective products to Sorensen will be paid by the purchaser.

If any questions arise concerning the warranty, check with Sorensen prior to taking any action.

When requesting information, assistance, or authorization to return a product, please state the model and serial number of the unit as listed on the enclosure ID label.

MODEL NUMBER: _____

SERIAL NUMBER: _____

SAFETY NOTICE

CAUTION

Before applying power to the unit, verify that the AC input selector switch is set to the voltage of the AC power source; exceeding the maximum rated AC input voltage could result in damage to the unit. To avoid a fire hazard, ensure that the AC input fuse has the proper rating for the AC power source voltage.

Before connecting the unit to the AC power source, ensure that the front panel POWER switch is in the OFF position.

WARNING

There are no operator serviceable components or adjustments within the unit. Hazardous voltages of up to 264VRMS, 373VPK may be present within the unit when the covers are removed. Only qualified service personnel should service this equipment.

Use caution when working inside the unit: Guard against risks of electrical shock during open cover checks by not touching any components, circuit boards, or test points with power applied to the unit. Even with power off, capacitors may retain an electrical charge that could be hazardous. Use safety glasses during open cover checks to avoid personal injury in case of sudden component failure.

WARNING

To prevent electrical shock, the enclosure of this unit must be connected to a safety earth ground. This is accomplished through the ground wire of the power cord. The ground terminal of the power cord must be connected to the safety ground of the AC power source. Do no remove the ground terminal of the power cord, and do not operate this unit with the enclosure ungrounded and floating.

High energy levels can be stored at the output terminals of the power supply during normal operation; use caution to prevent shorting the output terminals. Voltages of greater than 60VDC are considered dangerous; ensure that wiring and terminations going to the load are suitably insulated. Do not operate the power supply in an environment with a flammable atmosphere.

In servicing the power supply, substitution of parts or unauthorized modifications could compromise the safe operation of the unit and result in a hazardous condition.

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SECTION 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

The LS Models comprise a family of Laboratory Power Supplies designed for benchtop and portable applications. The family consists of two models encompassing voltage outputs of 18V and 30V, and current outputs of 5A and 3A. These power supplies could be manually adjusted or remotely programmed, and could be operated as variable voltage sources or current sources.

1.2 GENERAL DESCRIPTION

These power supplies utilize linear series-pass output stages to provide enhanced performance characteristics such as excellent regulation (0.01%), low noise (1mV), and fast transient response (100μs). They could be operated as precisely regulated voltage sources in constant-voltage (CV) mode or current sources in constant-current (CC) mode. Crossover between modes is automatic, being dependent on load demand.

Front panel controls are provided to adjust the voltage and current from 0 to 100% of rating. Coarse and fine controls for both voltage and current facilitate accurate setting of the output. A current range switch allows selection of full rated output or a reduced range permitting higher resolution of adjustment. The 3-1/2 digit LED display is provided that is switch-selectable to display either voltage or current. Also, front panel CV and CC indicators allow determination of whether the power supply is operating in constant-voltage or constant-current mode.

The output is isolated from the chassis. This allows operation with a floating output, or with either the positive or negative lead referenced to chassis ground. If an output voltage is required greater than available in a single unit, multiple units could be connected in series to provide a maximum output voltage of 300V. The output is fully protected for overload, short-circuit, and reverse polarity.

Binding posts are conveniently located on the front panel to provide connection for the power supply output as well as the chassis ground.

1.3 SPECIFICATIONS

1.3.1 Constant Voltage Operation

1.3.1.1 Output Voltage Adjustment Range

LS 18-5 0 to 18VDC
LS 30-3 0 to 30VDC

1.3.1.2 Output Voltage Line Regulation

≤0.01% + 3mV

1.3.1.3 Output Voltage Load Regulation

≤0.01% + 5mV for LS 18-5
≤0.01% + 3mV for LS 30-3

1.3.1.4 Output Voltage Temperature Coefficient

≤300PPM/°C

1.3.1.5 Output Voltage Recovery Time

≤100μs for 50% load change, 0.5A minimum load

1.3.1.6 Output Voltage Ripple and Noise

≤1mV(RMS) for LS 18-5, measured with a bandwidth of 5Hz to 1MHz
≤0.5mV(RMS) for LS 30-3, measured with a bandwidth of 5Hz to 1MHz

1.3.2 Constant Current Operation

1.3.2.1 Output Current Adjustment Range

LS 18-5 0 to 5ADC
LS 30-3 0 to 3ADC

1.3.2.2 Output Current Line Regulation

≤0.2% + 3mA

1.3.2.3 Output Current Load Regulation

≤0.2% + 3mA

1.3.2.4 Output Ripple Current

≤3mA(RMS)

1.3.3 AC Input Characteristics

1.3.3.1 AC Input Voltage Range

100V/120V/220V/240V ±10%, switch selectable

1.3.3.2 AC Input Frequency

50Hz or 60Hz

1.3.3.3 AC Input Fuse

T2.5A/250VAC, time-delay, for 100/120VAC operation
T1.25A/250VAC, time-delay, for 220/240VAC operation

1.3.4 Mechanical Specifications

1.3.4.1 Dimensions

128mm(W) × 145mm(H) × 285mm(D) (5.0"W × 5.7"H × 11.2"D)

1.3.4.2 Weight

5.5Kg (12.1lb) for LS 18-5
5.0Kg (11.0lb) for LS 30-3

1.3.5 Environmental

1.3.5.1 Operating Temperature Range

0°C to 40°C

1.3.5.2 Storage Temperature Range

-10°C to 70°C

1.3.5.3 Humidity

<80%, operating; <70%, storage

1.3.6 General Characteristics

1.3.6.1 Display Type

Digital, 3.5 digits, 0.5" red LED

1.3.6.2 Display Accuracy

±(0.5% of reading + 2 digits)

1.3.6.3 Display Voltage Range

19.99V for full scale in LS 18-5
199.9V for full scale in LS 30-3

1.3.6.4 Display Current Range

19.99A for full scale in HI range
1.999A for full scale in LO range

SECTION 2
INSTALLATION

2.1 INTRODUCTION

The LS Model Laboratory Power Supply has been fully calibrated and tested prior to shipment. Therefore, the unit is ready for immediate use upon receipt. However, when first unpacked, the unit should be inspected to ensure that no shipping damage had occurred.

2.2 INITIAL INSPECTION

Perform a visual inspection of the shipping container prior to accepting the package from the carrier. If extensive damage to the shipping container is evident, a description of the damage should be noted on the carrier's receipt and signed by the driver of the carrier's agent.

If damage is not apparent until the unit is unpacked, a claim for concealed damage should be placed with the carrier. In addition, the shipping container and filler material should be saved for inspection. Forward a report of the damage to the Sorensen Service Department. Sorensen will provide instructions for repair or replacement of the unit.

2.3 PHYSICAL INSPECTION

Perform a visual inspection of the unit after it is removed from the shipping container. Check for shipping damage such as dents, scratches, distortion of the enclosure, or damaged controls. If external damage is evident, remove the cover and also check for internal damage to circuit boards or components.

2.4 LOCATION OF APPLICATION

The unit is designed for benchtop and portable applications. Since it utilizes natural convection for cooling, it is important that adequate clearance is provided at the rear and sides of the unit so that air flow is not impeded around the external heat sink and from the perforations in the top cover. The temperature of the ambient air should not exceed 40°C.

2.5 INPUT POWER REQUIREMENTS

The unit will operate from an AC power source rated at 100/120/220/240VAC, ±10% at 50/60Hz. Before connecting to the AC power source, ensure that the AC LINE SELECT switches on the rear panel are set for the available voltage, and that the fuse rating is appropriate for the voltage selected. Refer to Figure 2-1 for the location of the AC LINE SELECT switches and the AC line fuse.

CAUTION

Exceeding the maximum rated AC input voltage could result in damage to the unit. Operating with a fuse of improper rating could result in a fire hazard.

An IEC connector is provided on the rear panel for connecting the unit to the AC power source with a power cord; the IEC connector also provides the safety ground termination. The power cord supplied with the unit has a safety ground wire that connects the enclosure of the unit to the safety ground of the AC power source. This connection is automatically made when the power cord is plugged into an appropriate AC receptacle.

WARNING

Operating the unit with the safety ground wire of the power cord disconnected could result in a shock hazard.

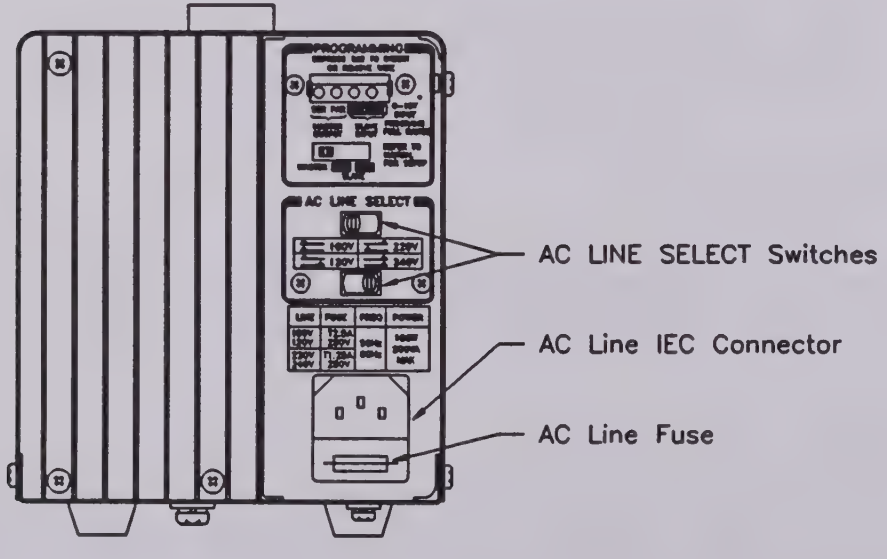

Figure 2-1. Rear Panel AC Switches, Fuse, and Connector

2.6 AC LINE VOLTAGE SELECTION

Determine the nominal voltage rating of the AC power source: either 100VAC, 120VAC, 220VAC, or 240VAC. Refer to Figure 2-1 for the positions of the AC LINE SELECT switches required to select one of the four nominal values.

CAUTION

To prevent damage to the unit, disconnect the AC power cord before changing the settings of the AC LINE SELECT switches on the rear panel.

2.7 AC LINE FUSE

Check that the fuse installed in the fuse holder has the proper rating for the AC power source voltage. To extract the fuse, snap out the plastic panel that holds the fuse in the fuse holder. The fuse ratings are listed in Subsection 1.3.3.3, AC INPUT FUSE, and also in a table on the rear panel of the unit. Refer to Figure 2-1 for the location of the table.

WARNING

To prevent electrical shock, disconnect the AC power cord before checking the fuse.

2.8 LOAD CONNECTIONS

2.8.1 Load Wiring

When connecting the load to the power supply, the following factors must be considered when selecting a suitable wire gauge:

1. The current carrying capacity of the wire (limited by temperature rise of the wire)

2. The voltage drop across the total length of load lines

3. Noise coupling and impedance effects of the load lines.

2.8.2 Wire Current Carrying Capacity

Load wiring must have a current carrying capacity greater than the output current rating of the power supply. This ensures that the wiring will not be damaged even if the load is shorted. Table 2-1 shows the maximum current rating, based on $450A/cm^2$, for various gauges of wire rated for 105°C operation. Operation at the maximum current rating results in approximately a 30°C temperature rise for a wire operating in free air. When load wiring must operate in

areas with elevated ambient temperature or bundled with other wiring, larger gauges or higher temperature-rated wiring should be used.

AWG	Copper Area cm^2	Resistance Ω/m, at 20°C	Resistance Ω/m, at 100°C	Current Rating A, at 450A/cm^2
6	0.13301	0.0013	0.0017	59.9
8	0.08368	0.0021	0.0028	37.7
10	0.05262	0.0033	0.0044	23.7
12	0.03309	0.0052	0.0069	14.9
14	0.02081	0.0083	0.0110	9.4
16	0.01309	0.0132	0.0174	5.9
18	0.00823	0.0209	0.0276	3.7
20	0.00518	0.0333	0.0440	2.3
22	0.00326	0.0530	0.0700	1.5

Table 2-1. Wire Data

2.8.3 Wire Voltage Drop

For applications where regulation is important, the contribution of the load wiring to voltage drop from the power supply output terminals to the load must be considered. The wire gauge must be selected to maintain an acceptable total voltage drop of the load wiring under the maximum peak current. The resistance of the load wiring must be determined for the sum total length of the positive lead and the negative lead. Table 2-1 gives the resistance per meter (m) of various wire gauges at 20°C and 100°C. The following equation could be used to calculate the resistance for other wire temperatures:

$$R = R_{20°C} \times [1 + 0.004 \times (T\text{-}20°C)]$$

where

R = resistance, Ω/m, at temperature T
$R_{20°C}$ = resistance, Ω/m, at 20°C
T = temperature, °C, of wire

The voltage drop (per positive or negative lead) could be calculated using the following equation:

$$V = I \times L \times R_{20°C} \times [1 + 0.004 \times (T\text{-}20°C)]$$

where

V = voltage drop, V
I = load current, A
L = length, m, of load wire
$R_{20°C}$ = resistance, Ω/m, of wire at 20°C
T = temperature, °C, of wire conducting load current

The total voltage drop would be calculated by summing the voltage drops of the positive and negative leads.

2.8.4 Noise and Impedance Effects

To minimize noise pickup or radiation from load circuits, load wires should be shielded twisted-pair with minimum lead length. Connect the shield only to the chassis of the power supply using the GND terminals. Even when shielding is impractical, the load wires should be twisted together to reduce noise coupling. When regulation is important, the wire gauge should be the largest practical and the wires should be twisted together to reduce their impedance.

2.9 LOAD CONNECTION CONFIGURATIONS

Both the positive and negative outputs of the power supply are isolated with respect to chassis ground. Either the positive or negative terminals could be connected to the chassis ground. Also, either the positive or negative leads could be floated up to 300VPK with respect to chassis ground.

CAUTION

Operating the power supply with either the positive or negative output lead floated greater than 300VPK above chassis ground could result in damage to the unit.

2.9.1 Connecting Single Loads

Single loads should be connected with the largest gauge and the shortest length wire that is possible. The output voltage will be precisely regulated at the output terminals on the front panel of the unit.

2.9.2 Connecting Multiple Loads

When output voltage regulation is critical and multiple loads are connected to the power supply, it is important to connect each load independently to the power supply terminals on the front panel of the unit. Independent leads to each load will ensure that the load currents do not produce voltage drops in the connecting leads that could be mutually coupled between the loads.

The connecting wires should be of the largest gauge and shortest length possible. Refer to Figure 2-2.

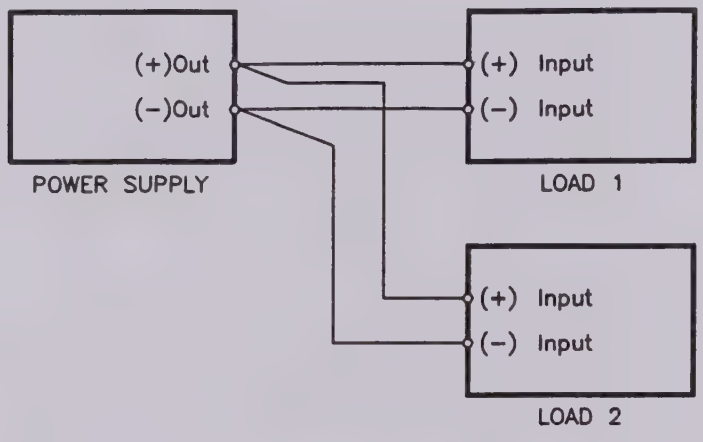

Figure 2-2. Multiple Load Connection

SECTION 3
OPERATION

3.1 INTRODUCTION

The LS Model Laboratory Power Supply has a full complement of controls, indicators, and connectors that allow the user to easily install, setup, and operate the unit.

3.2 CONTROLS, INDICATORS, AND CONNECTORS

Refer to Figure 3-1 for an illustration of the front panel and Figure 3-2 for an illustration of the rear panel.

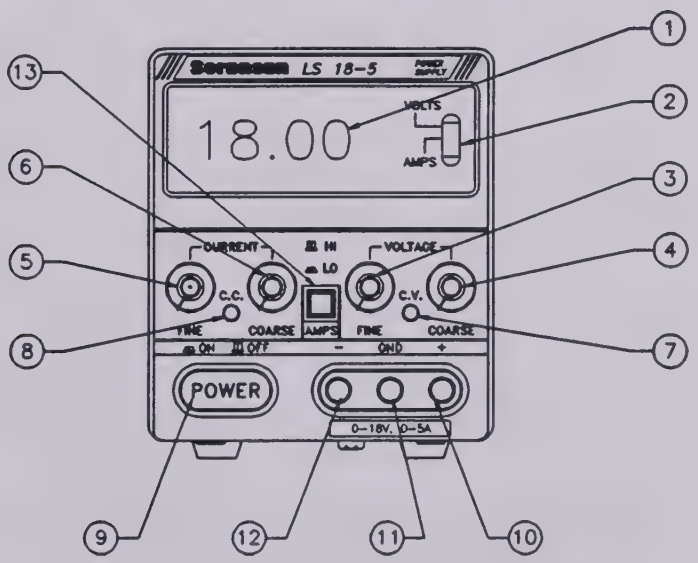

Figure 3-1. Front Panel Controls and Indicators

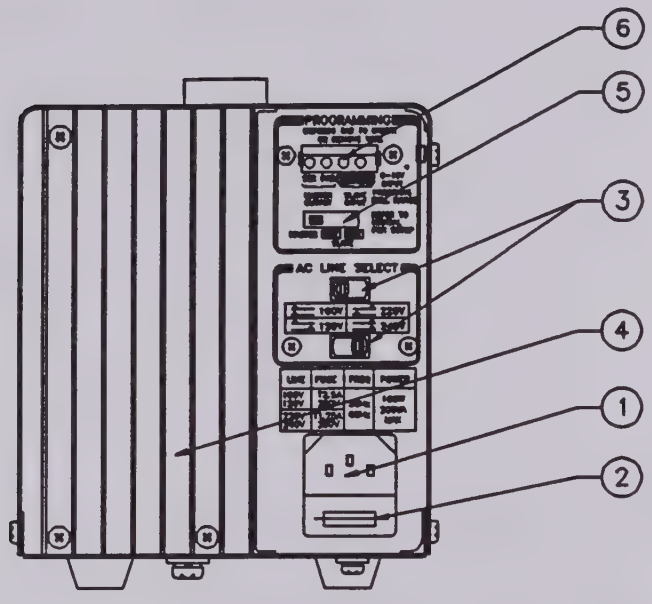

Figure 3-2. Rear Panel Controls and Connectors

3.3 FRONT PANEL

Refer to Figure 3-1 for the location of controls and indicators.

1. VOLTAGE/CURRENT DISPLAY: Indicates the value of the output voltage or the output current, as selected with the DISPLAY SELECTOR SWITCH.

2. DISPLAY SELECTOR SWITCH: Selects whether the output voltage or the output current is displayed; LED indicators identify which is selected.

3. VOLTAGE FINE CONTROL: Provides a fine adjustment of the output voltage.

4. VOLTAGE COARSE CONTROL: Provides a coarse adjustment of the output voltage.

5. CURRENT FINE CONTROL: Provides a fine adjustment of the output current.

6. CURRENT COARSE CONTROL: Provides a coarse adjustment of the output current.

7. CV INDICATOR: Indicates that the output is in constant-voltage mode. The output voltage is being regulated, and the output current could vary.

8. CC INDICATOR: Indicates that the output is in constant-current mode. The output current is being regulated, and the output voltage could vary.

9. POWER SWITCH: Turns the unit ON and OFF.

10. POSITIVE OUTPUT TERMINAL: Connects to the positive output. Colored red and labeled "+".

11. CHASSIS GROUND TERMINAL: Connects to the chassis ground. Colored green and labeled "GND".

12. NEGATIVE OUTPUT TERMINAL: Connects to the negative output. Colored black and labeled "-".

13. CURRENT RANGE SWITCH: Selects the range for the output current: HI for full rated output, and LO for up to 2A output.

3.4 REAR PANEL

Refer to Figure 3-2 for the location of controls and connectors.

1. AC LINE INPUT: IEC connector for the AC input power cord.

2. AC LINE FUSE HOLDER: Contains the AC input fuse. The fuse is located on a plastic panel that snaps into the body of the fuse holder.

3. AC LINE SELECT SWITCHES: Two switches that convert the operation of the unit for 100/120/220/240VAC AC power sources.

4. HEAT SINK: Provides cooling for internal power devices.

5. PROGRAMMING SWITCH: Configures unit for master/slave mode of operation. In the MASTER position, operation is possible as a stand-alone unit or as the master unit simultaneously controlling a slave unit in an parallel-tracking or series-tracking configuration.

   In the SLAVE position, operation is possible as a slave unit in a parallel-tracking or series-tracking configuration, or as a remotely programmed unit. The SLAVE-SER setting is used for the series-tracking configuration or for remote programming of the output voltage. The SLAVE-PAR setting is used for the parallel-tracking configuration or for remote programming of the output current.

6. PROGRAMMING CONNECTOR: Connector for the input/output signals used in the master/slave mode of operation or for remote programming.

   The MASTER OUTPUT terminals provide control output signals to the slave unit when the PROGRAMMING SWITCH is in the MASTER position: MASTER

OUTPUT-SER is an output control signal to the slave for series-tracking operation; MASTER OUTPUT-PAR is an output control signal to the slave for parallel-tracking operation.

The SLAVE INPUT terminals are for control input signals from the master unit or for remote programming when the PROGRAMMING SWITCH is in the SLAVE position: SLAVE INPUT-SER is an input for a control signal from the master unit when in the series-tracking mode of operation, or for a variable DC voltage for remote programming of the output voltage; SLAVE INPUT-PAR is an input for a control signal from the master unit when in the parallel-tracking mode of operation, or for a variable DC voltage for remote programming of the output current.

3.5 INITIAL FUNCTIONAL TESTS

3.5.1 Power-On Check

1. Ensure that the POWER switch is in the OFF position (switch button out).

2. Turn the COARSE and FINE controls for the VOLTAGE and CURRENT fully counterclockwise.

3. Connect the power cord to an AC power source that matches the voltage setting of the rear panel AC LINE SELECT switches.

4. Turn the front panel POWER switch to the ON position (switch button in).

5. Ensure that the front panel digital displays are on and that both the VOLTAGE and CURRENT displays indicate zero. Also, the CC indicator should be illuminated and the CV indicator should be off.

6. Turn the COARSE control for the CURRENT 1/2 clockwise. Ensure that the CV indicator is illuminated and that the CC indicator is off.

3.5.2 Constant-Voltage Mode Operation Check

1. Ensure that the front panel POWER switch is in the OFF position (switch button out).

2. Turn the VOLTAGE and CURRENT controls on the front panel fully counterclockwise.

3. Connect a digital voltmeter (DVM) to the output terminals on the front panel, observing the correct polarity. The DVM must have better than 0.1% accuracy.

4. Turn the COARSE control for the CURRENT 1/2 turn clockwise.

5. Turn the front panel POWER switch to the ON position (switch button in).

6. Slowly turn the COARSE control for the VOLTAGE clockwise and observe the values of the VOLTAGE display and the DVM. Adjust the COARSE and FINE controls for the VOLTAGE across their full ranges.

7. Compare the DVM reading with the front panel display reading to verify the accuracy of the front panel display for VOLTAGE.

8. Ensure that the controls for VOLTAGE adjust the output voltage across the full rated voltage range. Also, the CV indicator should be illuminated, and the CC indicator should be off.

3.5.3 Constant-Current Mode Operation Check

1. Ensure that the front panel POWER switch is in the OFF position (switch button out).

2. Turn the VOLTAGE and CURRENT controls on the front panel fully counterclockwise.

3. Turn the COARSE control for the VOLTAGE 1/2 turn clockwise.

4. Connect a DC shunt across the output terminals on the front panel. Ensure that the rating of the DC shunt and the wire exceed the output current capability of the power supply.

5. Connect a digital voltmeter (DVM) across the DC shunt, observing the correct polarity. The combined accuracy of the DVM and DC shunt must be better than 0.1%.

6. Turn the front panel POWER switch to the ON position (switch button in).

7. Turn the COARSE control for the CURRENT slowly clockwise and observe the values of the CURRENT display and the DVM. Adjust the COARSE and FINE controls for the CURRENT across their full ranges.

8. Compare the DVM reading with the front panel display reading to verify the accuracy of the front panel display for CURRENT. The DVM reading must be converted to current by multiplying the DVM reading by a conversion factor equal to the DC current rating of the shunt divided by the burden voltage rating of the shunt.

9. Ensure that the controls for CURRENT adjust the output current across the full rated current range. Also, the CC indicator should be illuminated, and the CV indicator should be off.

3.6 OPERATION SET-UP

The power supply is capable of operating in constant-voltage or constant-current mode. The mode of operation is dependent on the settings of the VOLTAGE and CURRENT controls and resistance of the load. The power supply could automatically crossover between the two modes of operation in response to load demands. The mode of operation is indicated with front panel LED's: CV for constant-voltage and CC for constant-current. Refer to Figure 3-3.

3.6.1 Constant-Voltage Mode of Operation

The power supply will operate in constant-voltage mode whenever the load current is less than the current setting. (Note that the load current is equal to the output voltage divided by the load resistance.) In this mode, the power supply maintains the output voltage precisely regulated to the voltage setting while the load current varies with the load requirements. This condition would be maintained as long as the load current is less than the current setting. If the load resistance decreases to where the load current attempts to exceed the current setting, the output current would be regulated at the set value and the output voltage would then decrease. This is the automatic crossover to constant-current mode of operation.

3.6.2 Constant-Current Mode of Operation

The power supply will operate in constant-current mode whenever the load resistance times the current limit setting is less than the voltage setting. In this mode, the power supply maintains the output current precisely regulated to the current setting while the load voltage varies with load requirements. This condition would be maintained as long as the load resistance is less than the voltage setting divided by the current setting. If the load resistance increases to where the load voltage attempts to exceed the voltage setting, the output voltage would be regulated to the set value and the output current would then decrease. This is the automatic crossover to constant-voltage mode of operation.

3.6.3 Adjustment of Constant-Voltage Operation

Use the following procedure to adjust the power supply for constant-voltage mode of operation:

1. Turn the front panel POWER switch to the ON position.

2. Adjust the VOLTAGE controls to the desired voltage setting. The CV indicator should be illuminated.

3. Turn the front panel POWER switch to the OFF position.

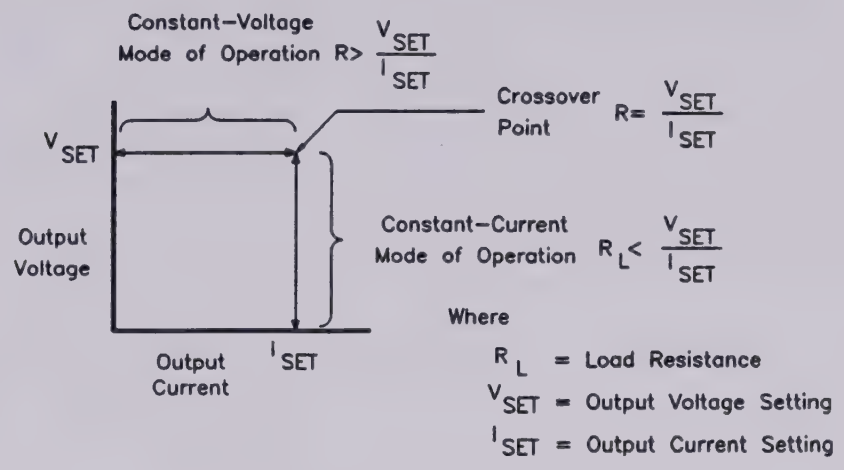

Figure 3-3. CV and CC Mode of Operation

4. Turn the front panel CURRENT controls to fully counterclockwise.

5. Short the positive and negative output terminals. Ensure that the jumper could safely conduct the maximum output current of the power supply.

6. Turn the front panel POWER switch to the ON position.

7. Adjust the CURRENT controls to the desired current limit value as would be determined by the load. The CC indicator should be illuminated.

   The current limit must be greater than the maximum peak current required by the load. If the load current attempts to exceed the limit value, the power supply will enter the constant-current mode of operation: The output voltage will decrease and will no longer be regulated.

8. Turn the front panel POWER switch to the OFF position. Remove the shorting jumper from the output terminals, and connect the load.

9. Turn the front panel POWER switch to the ON position.

3.6.4 Adjustment of Constant-Current Operation

Use the following procedure to adjust the power supply for constant-current mode of operation:

1. Turn the front panel POWER switch to the ON position.

2. Adjust the VOLTAGE controls to the desired voltage limit value as determined by the load. The CV indicator should be illuminated.

   The voltage limit must be greater than the maximum voltage drop required by the load while conducting the desired output current. If the load voltage attempts to exceed the limit value (resulting from a load resistance increase), the power supply will enter the constant-voltage mode of operation: The output current will decrease and will no longer be regulated.

3. Turn the front panel POWER switch to the OFF position.

4. Turn the front panel CURRENT controls to fully counterclockwise.

5. Short the positive and negative output terminals. Ensure that the jumper could safely conduct the maximum output current of the power supply.

6. Turn the front panel POWER switch to the ON position.

7. Adjust the CURRENT controls to the desired current setting. The CC indicator should be illuminated.

8. Turn the front panel POWER switch to the OFF position. Remove the shorting jumper from the output terminals, and connect the load.

9. Turn the front panel POWER switch to the ON position.

3.6.5 Series Operation of Multiple Supplies

Power supplies of the SAME MODEL may be operated with their outputs connected in series to increase the output voltage. Connect the negative output terminal of the first power supply to the positive terminal of the next supply; continue interconnecting the remaining supplies in the same manner. The output voltage is obtained from the positive terminal of the first supply and the negative terminal of the last supply. The total voltage available is the sum of the maximum voltages of each power supply. The maximum current available is the current rating of a single supply in the series string.

CAUTION

The maximum allowable sum of output voltages is 300VDC.

3.6.6 Series-Tracking Operation

Two power supplies could be connected for series-tracking operation in a master/slave configuration. Both power supplies are controlled simultaneously by the voltage and current

controls of the master unit. The series-connected outputs are utilized as a single output at twice the voltage rating of a single unit; the output current capability is equal to that of a single unit. Refer to Figure 3-4 for the interconnections between the master and slave units. Use the following procedure to configure the power supplies for the series-tracking mode of operation:

1. Ensure that the front panel POWER switch is in the OFF position (switch button out).

2. Configure one of the units as a master by setting the PROGRAMMING SWITCH to the MASTER position.

3. Configure one of the units as a slave by setting the PROGRAMMING SWITCH to the SLAVE-SER position.

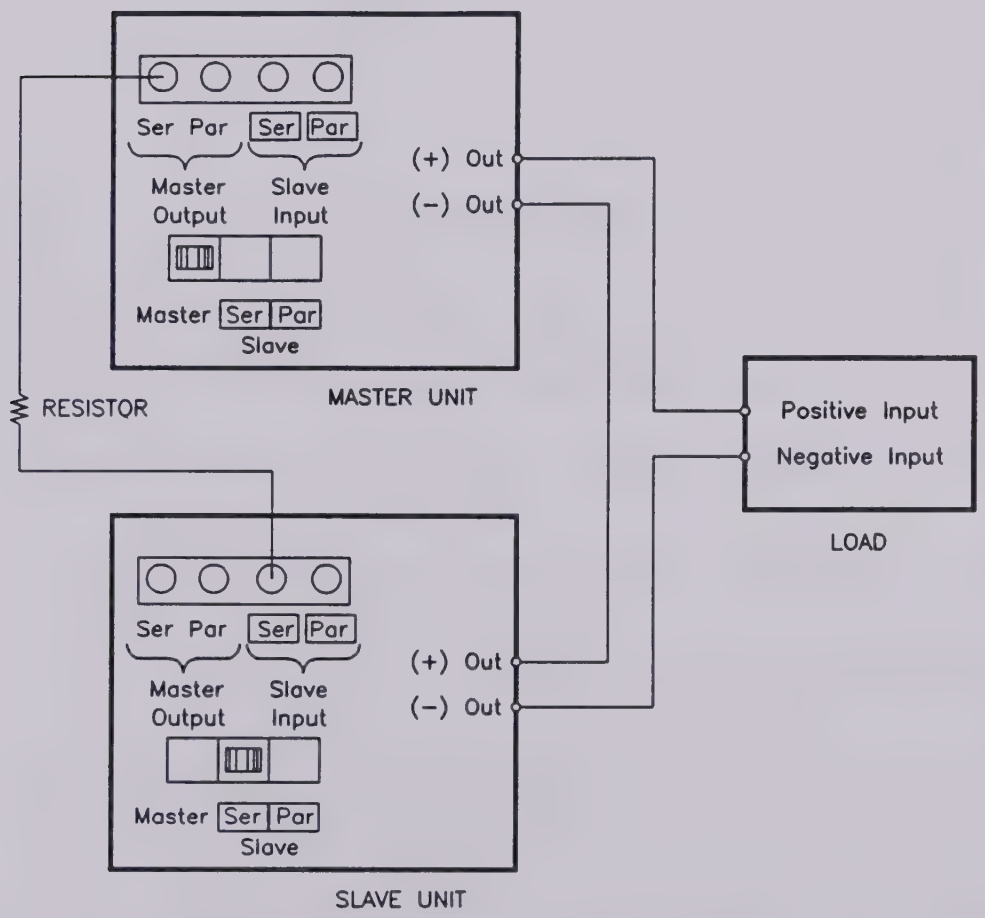

Figure 3-4. Interconnections for Series-Tracking Operation

4. A resistor must be connected from the MASTER OUTPUT-SER terminal of the PROGRAMMING CONNECTOR of the master unit to the SLAVE INPUT-SER terminal of the slave unit. The resistor should have a value of 511Ω, and it could be trimmed in value for precise tracking of the slave to the master.

5. Connect the POSITIVE output terminal of the slave unit to the NEGATIVE output terminal of the master unit.

6. Connected the load across the sum of the two outputs.

7. Set the VOLTAGE and CURRENT controls of the slave unit fully clockwise.

8. The output voltage and current is set with the controls of the master unit. The total output voltage is equal to the sum of the voltages indicated on the VOLTAGE displays of each unit. The output current, however, is equal to the current indicated on the CURRENT displays of each unit.

9. Turn the front panel POWER switch to the ON position.

3.6.7 Parallel-Tracking Operation

Two power supplies could be connected for parallel-tracking operation in a master/slave configuration. Both power supplies are controlled simultaneously by the voltage and current controls of the master unit. The parallel-connected outputs are utilized as a single output at twice the current rating of a single unit; the output voltage capability is equal to that of a single unit. Refer to Figure 3-5 for the interconnections between the master and slave units. Use the following procedure to configure the power supplies for the parallel-tracking mode of operation:

1. Ensure that the front panel POWER switch is in the OFF position (switch button out).

2. Configure one of the units as a master by setting the PROGRAMMING SWITCH to the MASTER position.

3. Configure one of the units as a slave by setting the PROGRAMMING SWITCH to the SLAVE-PAR position.

4. A jumper must be connected from the MASTER OUTPUT-PAR terminal of the PROGRAMMING CONNECTOR of the master unit to the SLAVE INPUT-PAR terminal of the slave unit.

5. Connect together the output terminals of the master and slave units: POSITIVE to POSITIVE and NEGATIVE to NEGATIVE.

6. Connected the load across the output terminals of the master unit.

7. Set the VOLTAGE and CURRENT controls of the slave unit fully clockwise.

8. The output voltage and current is set with the controls of the master unit. The output voltage setting of the master unit must be 0.2-0.5V less than that of the slave unit. The total output current is equal to the sum of the currents indicated on the CURRENT displays of each unit. The output voltage, however, is equal to the voltage indicated on the VOLTAGE displays of each unit.

9. Turn the front panel POWER switch to the ON position.

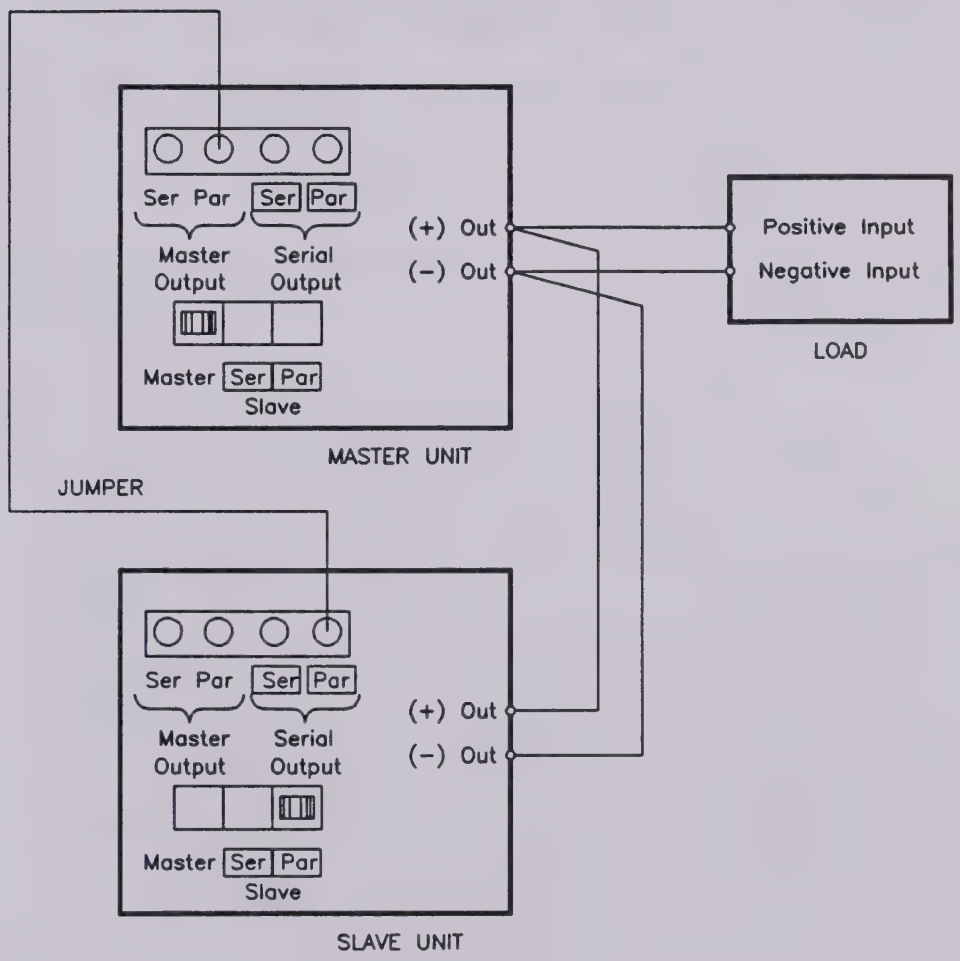

Figure 3-5. Interconnections for Parallel-Tracking Operation

3.6.8 Remote Programming of Output Voltage

The output voltage of a unit could be remotely programmed by using an external DC voltage source. The output voltage varies from zero to maximum as the external DC voltage source varies from 0 to 10V. Refer to Figure 3-6 for the interconnections between the power supply and the external source. Use the following procedure to configure the power supply for remote programming of the output voltage:

1. Ensure that the front panel POWER switch is in the OFF position (switch button out).

2. Set the PROGRAMMING SWITCH to the SLAVE-SER position.

3. Connect the positive terminal of the external voltage source to the SLAVE INPUT-SER terminal of the PROGRAMMING CONNECTOR.

4. Connect the negative terminal of the external voltage source to the POSITIVE output terminal of the unit.

5. Turn the front panel POWER switch to the ON position.

6. Adjust the external voltage source from 0 to 10V to program the output voltage of the unit across its full range.

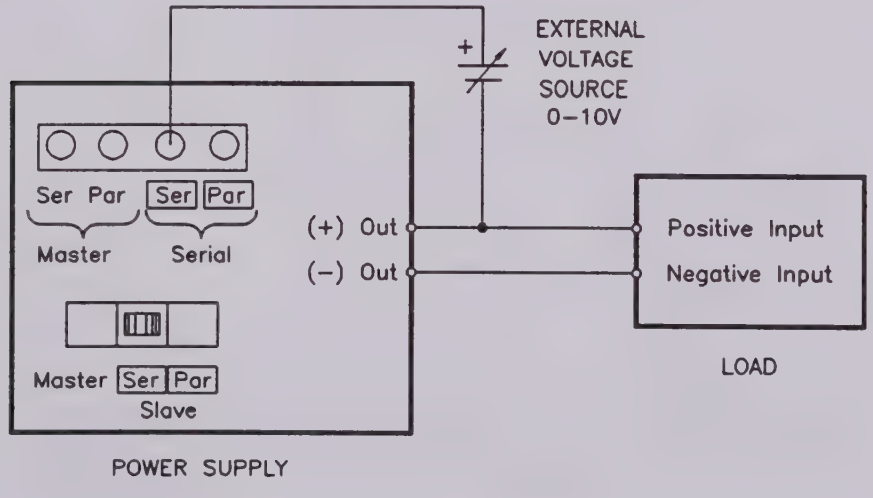

Figure 3-6. Interconnections for Remote Programming of Voltage

3.6.9 Remote Programming of Output Current

The output current of a unit could be remotely programmed by using an external DC voltage source. The output current varies from zero to maximum as the external DC voltage source varies from 0 to 10V. Refer to Figure 3-7 for the interconnections between the power supply and the external source. Use the following procedure to configure the power supply for remote programming of the output current:

1. Ensure that the front panel POWER switch is in the OFF position (switch button out).

2. Set the PROGRAMMING SWITCH to the SLAVE-PAR position.

3. Connect the negative terminal of the external voltage source to the SLAVE INPUT-PAR terminal of the PROGRAMMING CONNECTOR.

4. Connect the positive terminal of the external voltage source to the POSITIVE output terminal of the unit.

5. Turn the front panel POWER switch to the ON position.

6. Adjust the external voltage source from 0 to 10V to program the output current of the unit across its full range.

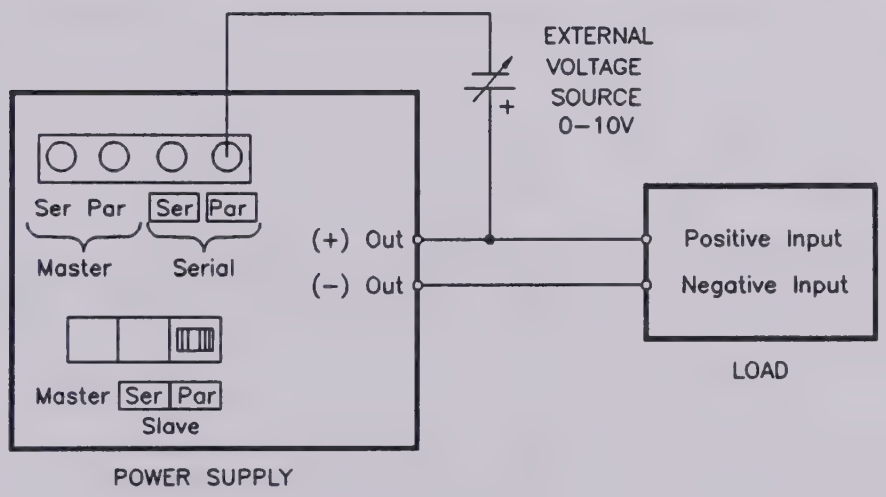

Figure 3-7. Interconnections for Remote Programming of Current

3.7 REVERSE POLARITY PROTECTION

The output of the power supply is protected against reverse polarity sources connected to the output terminals. The output terminals have a diode connected directly across them such that it is normally reversed-biased. If the voltage at the output terminals were to reverse in polarity, the diode would conduct and clamp it to its forward voltage drop.

CAUTION

Connecting a voltage source of reversed polarity to the output terminals could result in damage to the unit if the resulting current exceeds the current capabilities of the reverse polarity protection diode.

3.8 BATTERY CHARGING

When using a power supply to charge a battery, the following precautions should be taken:

1. Connect an isolation diode in series with one of the output terminals of the power supply. This diode will prevent discharge of the battery if the power supply were to be turned off. The diode must have suitable current and voltage ratings and should be mounted on an appropriate heat sink.

2. Adjust the VOLTAGE setting to the desired float voltage with the power supply disconnected from the battery. The VOLTAGE setting should compensate for the voltage drop of the isolation diode.

3. Adjust the CURRENT setting to the desired current limit value when charging a battery.

When recharging a battery, the power supply will initially operate in constant-current mode, regulating the output current to the current limit value. As the battery charges, the battery voltage would increase until the float voltage setting is reached.

The power supply would then enter the constant-voltage mode of operation, regulating the output voltage at the float voltage setting. The battery current would then decrease from the current limit setting and eventually drop to a low float current level when the battery is fully charged.

SECTION 4
MAINTENANCE

WARNING

Servicing should be performed only by qualified personnel. Operator personnel should not remove the enclosure top cover. Follow the safety precautions listed in Section SAFETY NOTICE at the beginning of this manual.

4.1 GENERAL SERVICING

If the power supply appears to be operating improperly, determine whether the power supply or the load is the cause by performing the tests presented in Subsection 3.5, INITIAL FUNCTIONAL TESTS.

If the power supply fails to operate, and the front panel displays (VOLTAGE and CURRENT) and indicators (CV or CC) are not illuminated, perform the basic tests of Subsections 4.1.1 through 4.1.3.

4.1.1 AC LINE SELECT Switch Settings

Ensure that the rear panel AC LINE SELECT switches are set for the available AC power source voltage. Refer to Subsection 2.6, AC LINE VOLTAGE SELECTION, for instructions on how to change the switch settings.

4.1.2 AC Line Cord Test

Determine the condition of the AC power cord by measuring with an ohmmeter the resistance of the connections between the plug and connector. Ensure that continuity exists between corresponding supply and ground terminals of the plug and connector. Replace a cord that measures a high resistance or open circuit, or that has a damaged cable, plug, or connector.

4.1.3 AC Line Fuse Test

Ensure that the AC input fuse has the proper rating. Refer to Subsection 2.7, AC LINE FUSE, for instructions on how to remove the AC input fuse. If the fuse rating is correct, determine whether the fuse is open by measuring with an ohmmeter the resistance of the fuse. Replace an open fuse only with one of the proper rating. If the fuse is replaced and opens again, there is a problem internal to the unit that would require servicing by qualified personnel.

4.1.4 Cleaning

The exterior of the unit should be cleaned with a mild solution of detergent and water. The solution should be applied onto a soft cloth, and not directly to the surface of the unit. To prevent damage to materials, do not use aromatic hydrocarbons or chlorinated solvents for cleaning.

4.2 CALIBRATION

WARNING

The calibration procedures are performed with the power supply top cover removed and the power on. Adjustment potentiometers are located in circuits that are connected to potentially lethal voltages. Use insulated tools when making adjustments to circuit potentiometers, and do not touch any components or circuits. To prevent personal injury, follow the safety precautions listed in Section SAFETY NOTICE in the beginning of this manual.

The power supply has been fully calibrated prior to shipment. Typically, readjustment is not necessary unless components or circuit board assemblies have been replaced. If readjustment is to be performed, the accuracy of the voltmeter used for voltage measurements and the combined accuracy of the voltmeter and DC shunt used for current measurements must be better than 0.1%. Refer to Figures 4-1, 4-2, 4-3, and 4-4 for the location of the adjustment potentiometers.

4.2.1 Output Voltage Zero Adjustment

Use the following procedure to adjust the output voltage minimum value to 0V:

1. Connect an external voltmeter across the output terminals of the power supply.

2. Set the COARSE and FINE VOLTAGE controls to their minimum settings (fully counterclockwise).

3. Adjust potentiometer VR106 on the Main Control Board for a reading of 0V on the external voltmeter.

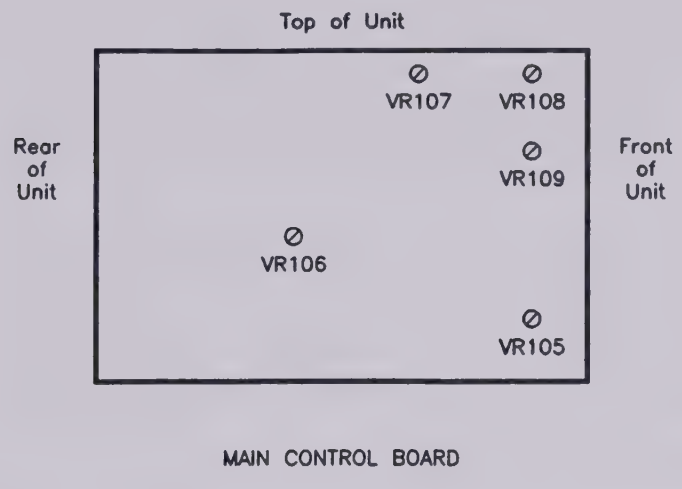

Figure 4-1. Main Control Board Potentiometer Locations

4.2.2 Output Voltage Range Adjustment

Use the following procedure to adjust the output voltage maximum value:

1. Connect an external voltmeter across the output terminals of the power supply.

2. Set the COARSE and FINE VOLTAGE controls to their maximum settings (fully clockwise).

3. Adjust potentiometer VR105 on the Main Control Board for a reading on the external voltmeter of 1.05 times the rated output voltage of the unit.

4.2.3 Voltage Display Adjustment

After performing the steps in Subsection 4.2.2, OUTPUT VOLTAGE RANGE ADJUSTMENT, use the following procedure to adjust the VOLTAGE display:

1. Reset the COARSE and FINE VOLTAGE controls so that the external voltmeter reading is equal to the rated output voltage of the unit.

2. Adjust potentiometer VR201 on the Display Board so that the unit's VOLTAGE display has a reading equal to the rated output voltage of the unit.

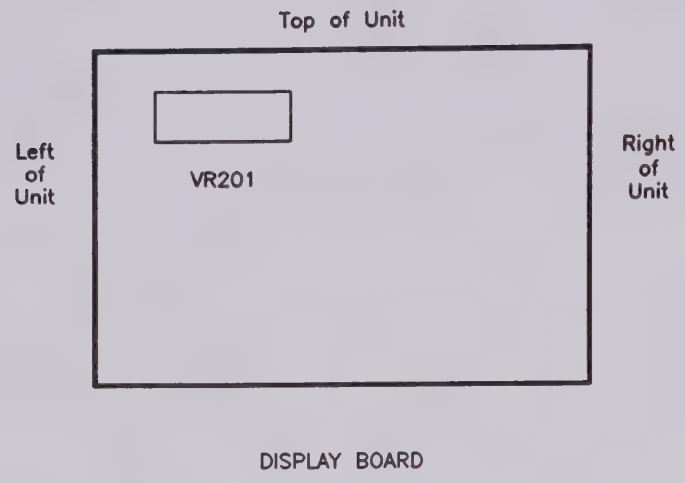

Figure 4-2. Display Board Potentiometer Locations

4.2.4 Output Current Zero Adjustment

Use the following procedure to adjust the output current minimum value to 0A:

1. Set the COARSE and FINE CURRENT controls to their minimum settings (fully counterclockwise).

2. With the power supply turned off, connect an external DC shunt across the output terminals of the power supply. Ensure that the current rating of the DC shunt and wiring exceed 1.05 times the rated output current of the unit.

3. Set the COARSE and FINE VOLTAGE controls so that the output voltage is 5V.

4. Adjust potentiometer VR107 on the Main Control Board for a reading of 0A through the current shunt.

4.2.5 Output Current Range Adjustment

Use the following procedure to adjust the output current maximum value:

1. Set the COARSE and FINE VOLTAGE controls so that the output voltage is 5V.

2. With the power supply turned off, connect an external DC shunt across the output terminals of the power supply. Ensure that the current rating of the DC

shunt and wiring exceed 1.05 times the rated output current of the unit.

3. Set the COARSE and FINE CURRENT controls to their maximum settings (fully clockwise).

4. Set the CURRENT RANGE switch to the HI position. Adjust potentiometer VR109 on the Main Control Board while monitoring the reading on the external voltmeter. Calculate the output current by multiplying the voltage reading by a conversion factor equal to the rated current of the DC shunt divided by the rated burden voltage of the DC shunt. Adjust for an output current equal to 1.05 times the rated output current of the unit.

5. Set the CURRENT RANGE switch to the LO position. Adjust potentiometer VR108 on the Main Control Board while monitoring the reading on the external voltmeter. Calculate the output current by multiplying the voltage reading by a conversion factor equal to the rated current of the DC shunt divided by the rated burden voltage of the DC shunt. Adjust for an output current equal to 1.999A.

4.2.6 Current Display Adjustment

After performing the steps in Subsection 4.2.5, OUTPUT CURRENT RANGE ADJUSTMENT, use the following procedure to adjust the CURRENT display:

1. Set the CURRENT RANGE switch to the HI position. Reset the COARSE and FINE CURRENT controls while monitoring the reading on the external voltmeter. Calculate the output current by multiplying the voltage reading by a conversion factor equal to the rated current of the DC shunt divided by the rated burden voltage of the DC shunt. Reset the controls for an output current equal to the rated output current of the unit.

2. Adjust potentiometer VR110 on the Front Panel Board so that the unit's CURRENT display has a reading equal to the rated output current of the unit.

3. Set the CURRENT RANGE switch to the LO position. Reset the COARSE and FINE CURRENT controls while monitoring the reading on the external voltmeter. Calculate the output current by multiplying the voltage reading by a conversion factor equal to the rated current of the DC shunt divided by the rated burden voltage of the DC shunt. Reset the controls for an output current equal to 1.999A.

4. Adjust potentiometer VR111 on the Front Panel Board so that the unit's CURRENT display has a reading equal to 1.999A.

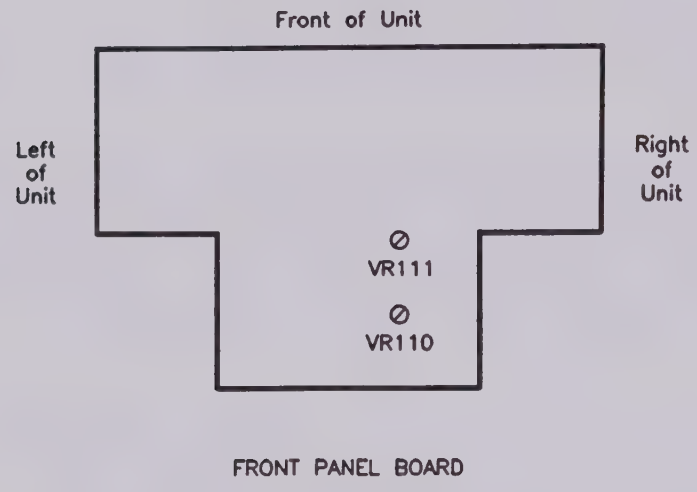

Figure 4-3. Front Panel Board Potentiometer Locations

4.2.7 Programming and Series-Tracking Range Adjustment

Use the following procedure to adjust the output voltage maximum value of the unit while configured for remote programming and the tracking to the master unit while configured for series-tracking operation:

1. Configure the unit for remote programming of the output voltage as specified in Section 3.6.8, REMOTE PROGRAMMING OF OUTPUT VOLTAGE.

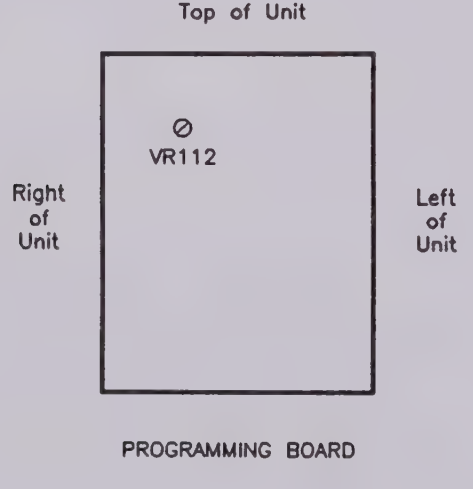

Figure 4-4. Programming Board Potentiometer Location

2. Connect an external voltmeter across the output terminals of the power supply.

3. Adjust the external voltage source for 10.0V.

4. Adjust potentiometer VR112 on the Programming Board so that the voltage measured on the external voltmeter equals the rated output voltage of the unit

4.3 FACTORY SERVICE INFORMATION

Questions concerning the operation, repair, or service of a power supply should be directed to the nearest Sorensen representative or to the Sorensen Service Department: Sorensen, Division of Elgar, 9250 Brown Deer Road, San Diego, CA 92121; Service Telephone Number 1-800-458-4258. Include the model number and the serial number in any correspondence concerning a power supply.

To return a defective unit, contact a Sorensen representative or the Sorensen factory and obtain an RMA number for return authorization. Unauthorized returns will not be accepted and will be returned at the shipper's expense.

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